New Journal of Physics 2013 vol.15

Scalable time reversal of Raman echo quantum memory and quantum waveform conversion of light pulse

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Abstract

We have found a new hidden symmetry of time reversal light-atom interaction in the photon echo quantum memory with Raman atomic transition. The time-reversed quantum memory creates generalized conditions for the ideal compression/decompression of time duration of the input light pulses and its wavelength. Based on a general analytical approach to this scheme, we have studied the optimal conditions for the light field compression/decompression in resonant atomic systems characterized by realistic spectral properties. The demonstrated necessary conditions for the effective quantum conversion of the light waveform and wavelength are also discussed for various possible realizations of the quantum memory scheme. The performed study promises new capabilities for fundamental study of the light-atom interaction and deterministic quantum manipulation of the light field, significant for quantum communication and quantum computing. © IOP Publishing and Deutsche Physikalische Gesellschaft.

http://dx.doi.org/10.1088/1367-2630/15/10/105005